BOONTON ELECTRONICS CORPORATION

OPERATING AND SERVICING MANUAL

MODEL 16A

VOLTAGE RAMP GENERATOR

MP MASTER
MA24303

BOONTON ELECTRONICS CORPORATION

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9-72/16A a

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1.	Front Panel Layout	BX5218-26 (016003)
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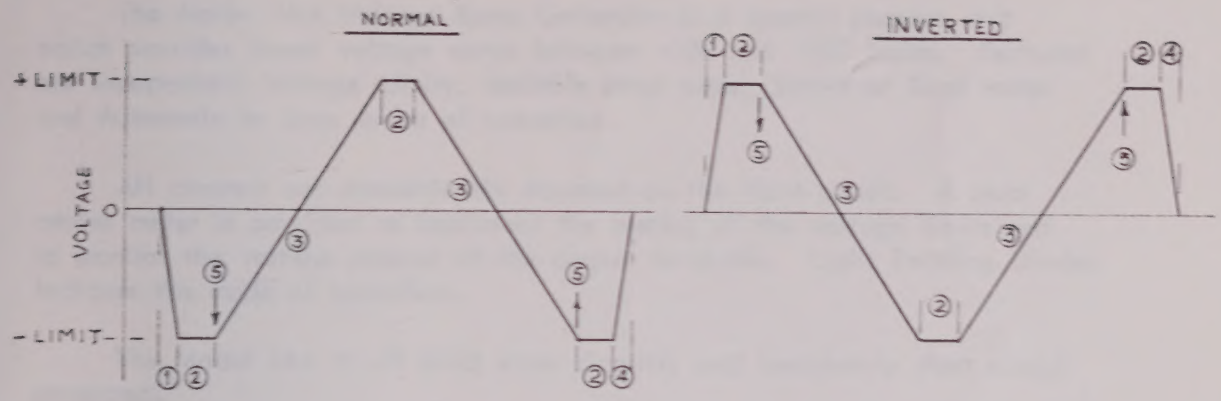
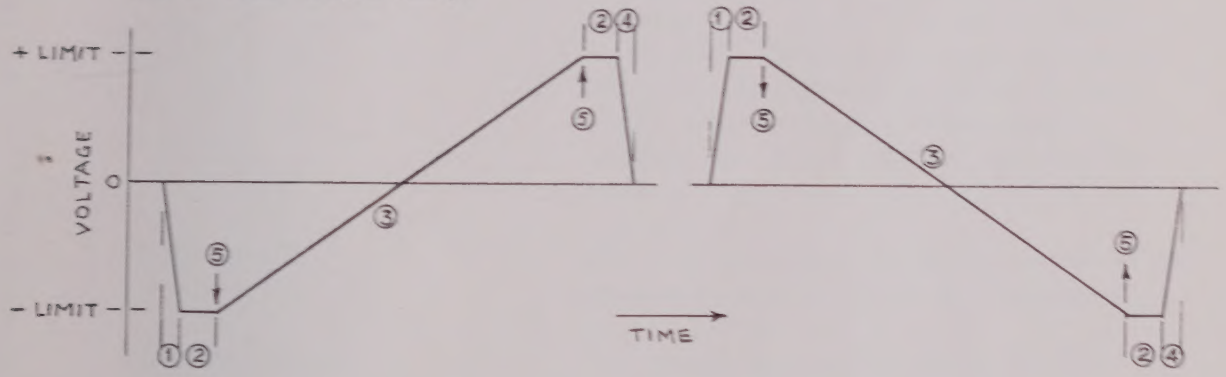
I. SPECIFICATIONS

1-1	Ramp Voltage Range:	2 Ranges, ±10 Volts F.S. and ±100 Volts F.S.
1-2	Ramp Voltage Limits:	Voltage Limits established by independent + and - Limit Controls. Continuously adjustable from 0 to Full Scale.
1-3	Ramp Rate:	Continuously adjustable from 0.1 Volts/Sec. to 2.0 Volts/Sec.
1-4	Ramp Voltage Display:	Zero center 2-1/2" edgewise panel meter calibrated -10 0 +10. Meter accuracy of ±3% F.S.
1-5	Ramp Voltage Output Connection:	Standard Binding Posts and Amphenol 57-40140 14 pin connector on rear panel.
1-6	Repeatability of Ramp:	
1-6-1	End Point (Voltage):	±0.1%
1-6-2	Time:	±0.05%
1-6-3	Linearity:	±0.05%
1-7	Output Ripple and Noise:	<1mV RMS on 10 Volt Range <10mV RMS on 100 Volt Range
1-8	Output Current:	Short Circuit Current. 10mA on both Ranges.
1-9	Modes of Operation	

1-9-1 Auto-Dual Ramp:



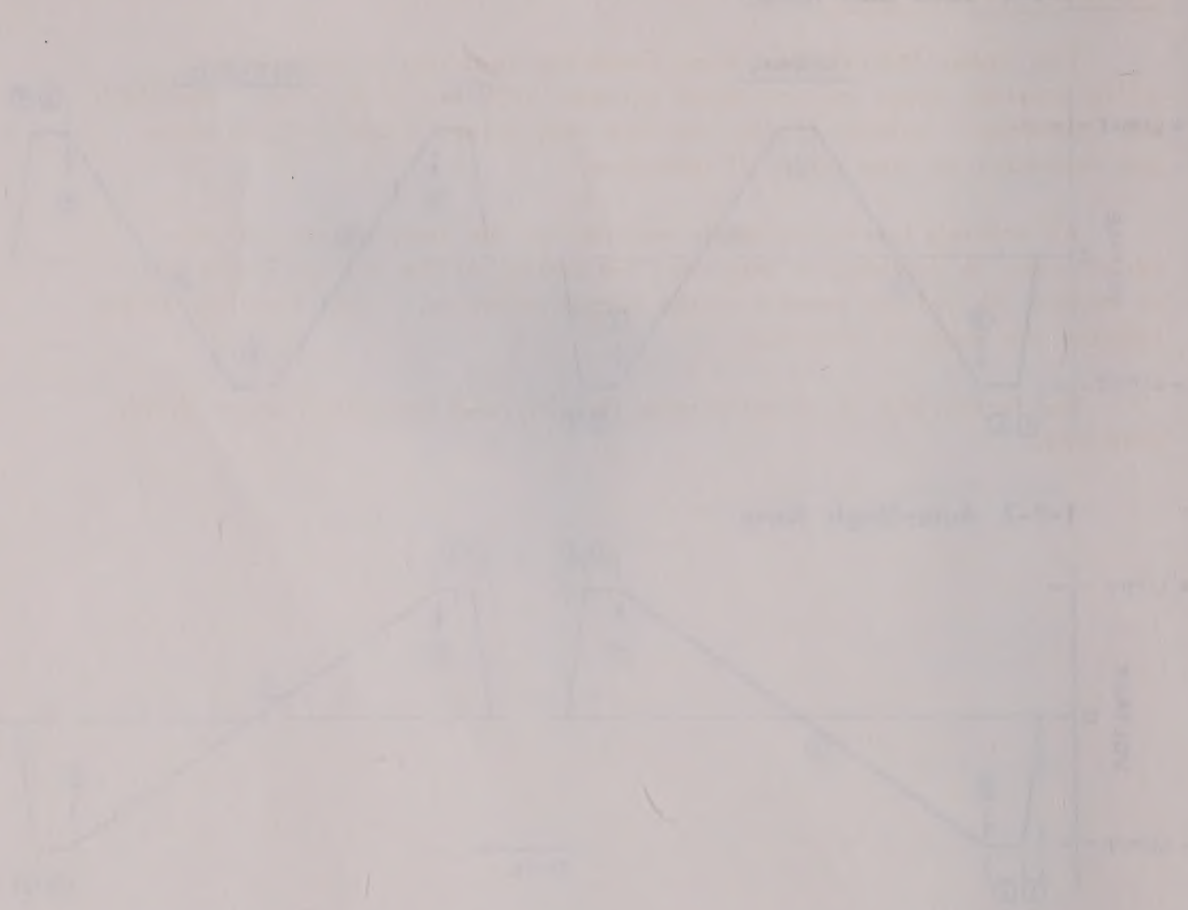
1-9-2 Auto-Single Ramp:



Notes:

1. Rate fixed at approximately 10 Volts/Second
2. Hold delay at approximately 1 second
3. Ramp Rate set by Ramp Rate Control from 0.1 Volt/Second to 2.0 Volts/Second
4. Return from Max Limit to Zero at approximately 10 Volts/Second
5. Pen Down/Pen Up commands for use with Model 52-9A X-Y Recorder

1-9-3 Step: Ramp goes to Limit and holds each time Start button is depressed. Ramp traces same path as Auto Mode with automatic hold at each Voltage Limit.



II. GENERAL DESCRIPTION

The Model 16A Voltage Ramp Generator is a special purpose unit which provides linear voltage ramps between -100 and +100 Volts. Featured are independent Voltage Limits, variable ramp rates, Single or Dual ramps and Automatic or Step modes of operation.

All controls are conveniently mounted on the front panel. A zero center meter is provided to impliment the setting of the voltage limits and to monitor the voltage present at the output terminals. Light Emitting Diodes indicate the mode of operation.

The Model 16A is all solid state circuitry and completely short circuit protected.

II. OPERATING INSTRUCTIONS

3-1 Front Panel Operating Controls and Indicators

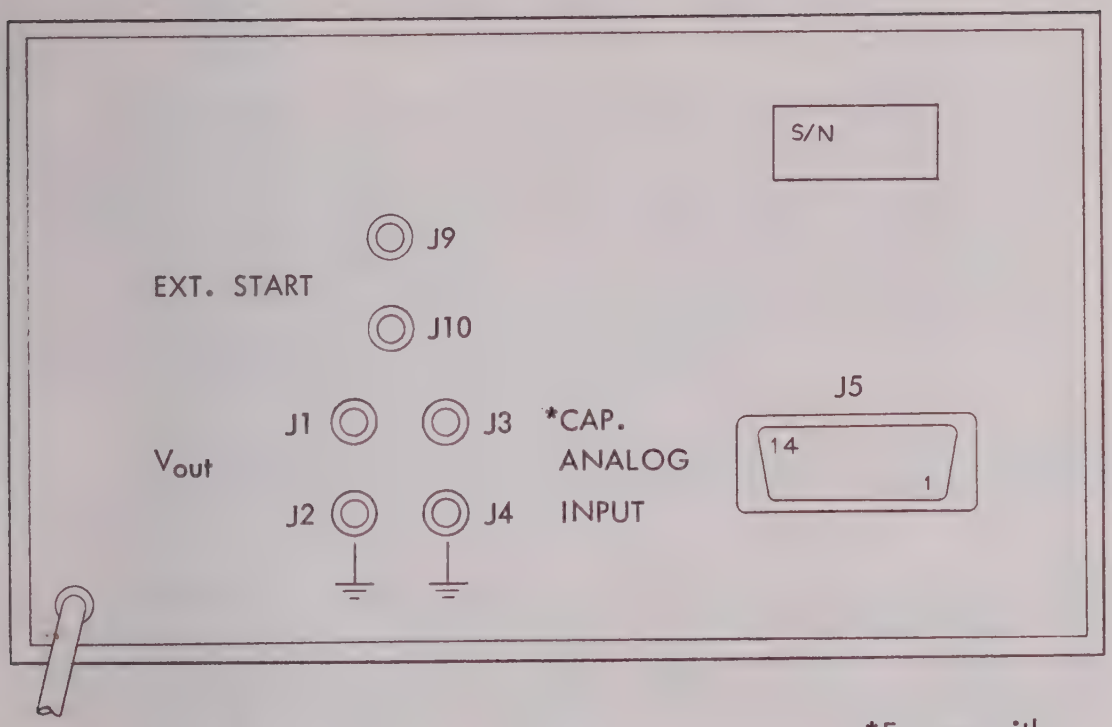
ITEM	FUNCTION
POWER Switch	This push-push type switch turns on the ac primary power. The plastic button cover also serves as the pilot lamp.
FUSE Holder	This contains the main line fuse which should be a 3AG type at 1 ampere.
AUTO-STEP Switch	This switch defines the operating mode. In the AUTO position, the voltage ramp will automatically step through the ramp program upon receipt of a START signal. In the STEP position, the ramp program is advances one segment at a time for each START signal. Light emitting diodes indicate the switch position and operating mode.
START Switch	This is a momentary pushbutton switch which provides a manual START or STEP signal.
100V/10V Switch	This rocker-type switch selects the full scale range of the output voltage.
NORMAL/INVERT Switch	This rocker-type switch is used to select the initial direction (- to + or + to -) of the voltage ramp which is graphically shown in Paragraph 1-9 of the Specifications.
SINGLE/DUAL Switch	This rocker-type switch is used to select either a SINGLE or DUAL voltage ramp as graphically shown in Paragraph 1-9 of the Specifications.

ITEM	FUNCTION
+ LIMIT/- LIMIT Switch	This is a 3-position rocker-type switch which is used in conjunction with the + LIMIT and - LIMIT controls to establish the maximum positive and negative excursions of the voltage ramp. Once the maximum voltage values are established, the switch is returned to the center position.
RAMP RATE	This continuously variable uncalibrated control is used to set the ramp rate (time rate of change). At SLOW, the ramp rate is approximately 0.1 Volt/Second. At FAST, the rate is approximately 2.0 Volts/ Second.
- LIMIT	This continuously variable uncalibrated control is used in conjunction with the + LIMIT/- LIMIT Switch and establishes the voltage value of the negative Limit between MIN (Zero) and MAX (Full Scale) of voltage range selected.
+ LIMIT	Same as - LIMIT, except for establishment of the positive voltage value.
METER	This provides a means of continuous visual tracking of the output voltage and is also used to set the + and - LIMIT to absolute value.

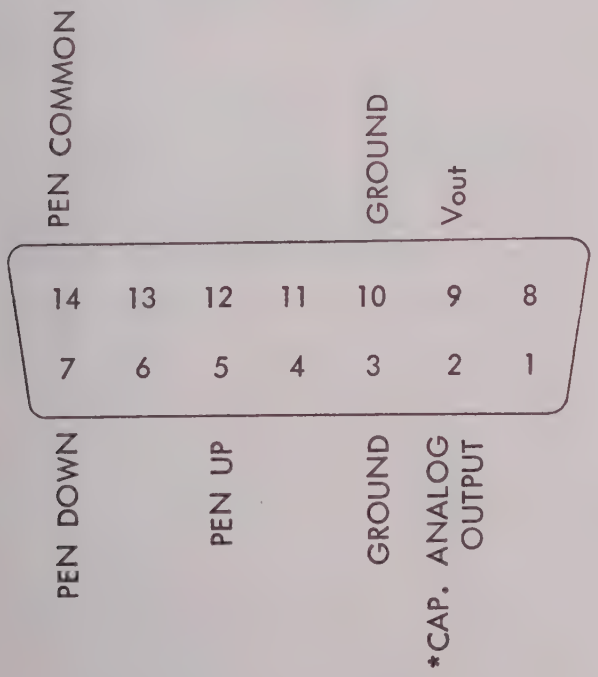
3-2 Rear Terminal Connections

ITEM	FUNCTION
EXT STEP	Connection of a momentary contact switch or relay between J9 and J10 will provide a means of remote START or STEP. These connections are in parallel with the Front Panel Start Switch.

ITEM	FUNCTION
Vout	The voltage output appear between J1 and J2 with J2 at ground.
CAP ANALOG INPUT	This is a "convenience" connection for use in a Model 179A C-V Plotter System and permits the use of a single interconnecting cable to the Model 52-9A X-Y Recorder.
J5	This connector is primarily used in the Model 179A C-V Plotter System and contains the I/O information essential to the Model 52-9A X-Y Recorder. The J5 pin assignments are as follows: 1. NC 2. Capacitance Analog Output 3. Ground 4. NC 5. Pen Up 6. NC 7. Pen Down 8. NC 9. Vout 10. Ground 11. NC 12. NC 13. NC 14. Pen Common



*For use with 179A System



J5 PIN ASSIGNMENTS

REAR TERMINAL CONNECTIONS

V. THEORY OF OPERATION

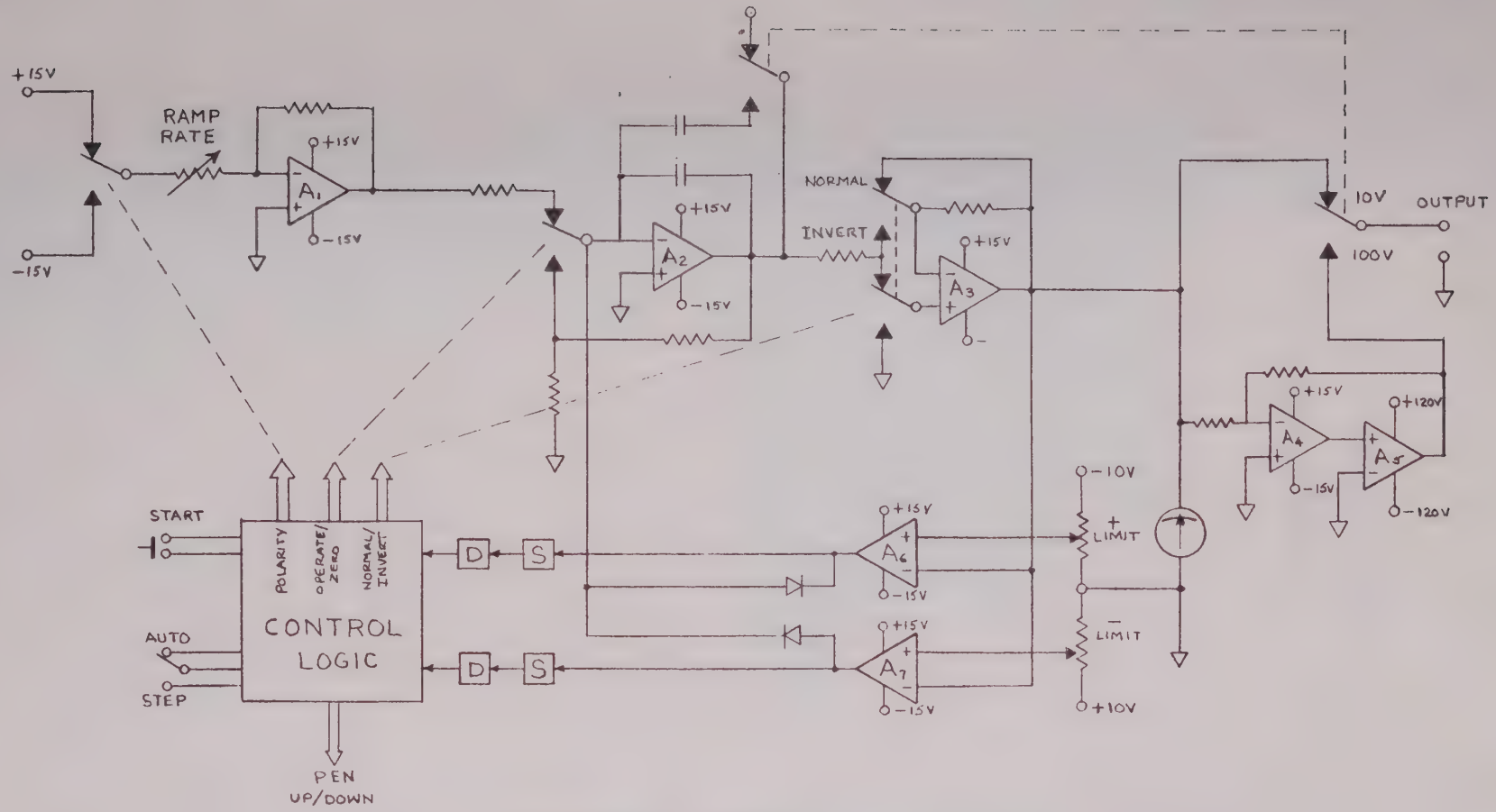
(Refer to the Simplified Schematic, Figure 1, in connection with this explanation)

The RAMP RATE Control, which forms part of the variable feedback network around the operational amplifier A1, is returned to a + or - 15 Volt source and establishes a DC level at the output of A1 which is inversely proportional to the resistance of the RAMP RATE control. Amplifier A2 is an integrator whose input resistance and voltage determines the charging current of the feedback capacitor(s). The output of A2 is thus a linear voltage ramp. The characteristic of this voltage ramp is determined by the magnitude and polarity of the voltage input to A2. To reverse the ramp slope, the input voltage polarity is merely reversed.

The ramp return to zero volts is programmed by a relay which establishes a low resistance path to ground around A2 which allows the feedback capacitor(s) to discharge.

Amplifier A3, which is relay programmed as either a unity gain inverter or follower, provides the direct output for the 10 Volt Full Scale range. The 100 Volt Full Scale output uses the high voltage combination of amplifiers A4 and A5 operating at a gain of 10 directly from the 10 Volt Full Scale output. The meter at the 10 Volt output will track and display output of both the 10 and 100 Volt ranges.

The reference voltage at the outputs of the two LIMIT controls are fed to individual comparators, A6 and A7, which act as cross-over detectors and clamp the integrator, A2, to some peak value. These same two comparators provide internal Signals to the Control Logic Circuitry for the function commands of Polarity, Operate/Zero and Pen Up/Down.



SIMPLIFIED DIAGRAM

FIG. 1

TABLE OF REPLACEABLE PARTS

FRONT PANEL ASSEMBLY

rence	Description	BEC Part No.
	Lamp, Incandescant G.E. 337	545122
4	Diode, Light Emitting MV5023	536000
	Fuse Lampere, Buss AGC-1	545500
	Fuseholder, Littlefuse 348-6-5-7	482107
	Meter, Simpson Model 1522 500-0-500μa	554275
	Resistor, Variable AB Type J 100KΩ	311130
3	Resistor, Variable AB Type J 10K	311154
, SW3	Switch, Rocker C-H 8142K22E6M52	465176
	Switch, Rocker C-H 8144K22A1M52	465177
	Switch, Rocker C-H 8144K20A1M52	465178
	Switch, Pushbutton Dialco 513-1410-004	465156
	Switch, Rotary 4 Pole 2 Pos. Mallory 3242J	466223
	Switch, Pushbutton Dialco 513-1710-004	465158
	Capacitor, Paper .1/200V 10%	234005

TABLE OF REPLACEABLE PARTS

CHASSIS ASSEMBLY

Reference	Description	BEC Part No.
C1-C4	Capacitor, Ceramic 0.1μfd/500V	224135
C5	Capacitor, Mylar .22μfd 100V 20%	236005
CR1	Diode, 1N456A G.I.	530051
J1, J3, J9	Binding Post, Red GR938-WR	740134
J2, J4, J10	Binding Post, Black GR938-WB	740120
J5	Receptacle, Amphenol 57-40140	479223
K1	Relay, Mercury Wetted Adlake MWS7-16261-1	471004
L1, L2	Choke, Line Miller 7825	400255
R4	Resistor, Composition 560Ω 1/2W 5% AB	301081
T1	Transformer, Invertronics E649	446065
C7	Capacitor, Electrolytic 50mfd 50V	283149
R5	Resistor, Composition 3Ω 1/2W 5% AB	301504

TABLE OF REPLACEABLE PARTS

(016005)
COMPONENT BOARD ASSEMBLY - DX5218-16-1&2

Reference	Description	BEC Part No.
A1, A5, A7	Amplifier, Operational Philbrick 1421	421021
A2	Amplifier, Operational Philbrick 1021	421015
A3, A4, A6	Amplifier, Operational Philbrick 1413	421018
C1, C2, C5-C12, C15, C16, C25, C29, C30	Capacitor, Ceramic 0.1mfd/25V	224124
C3	Capacitor, Mylar 0.1mfd/100V	236011
C4	Capacitor, Mylar 1.0mfd/100V	236007
C13, C26, C27	Capacitor, Ceramic 0.01mfd/25V	224134
C14	Capacitor, Paper 0.047mfd/200V	234036
C17	Capacitor, Mylar 0.5mfd/100V	234034
C19, C20, C18	Capacitor, Tantalum 1.0mfd/50V	283275
C21	Capacitor, Tantalum 22mfd/15V	283237
C22	Capacitor, Electrolytic 10mfd/25V	283193
C23, C24	Capacitor, Electrolytic 200mfd/250V	283298
C28	Capacitor, Paper 0.1mfd/200V	234005
C31, C32	Capacitor, Mica 2000pf/500V	200500
C33-C42	Capacitor, Ceramic 0.01mfd/100V	224119
CR1, CR2, CR16-CR19	Diode, FD300	530052
CR3-CR6	Diode, Rectifier 1N2070	530088
CR7	Delete	
CR8-CR15, CR16	Diode, G.I. 1N456A	530051
P1	Integrated Circuit SN74121N	534038
P2	Integrated Circuit SN7493N	534033
P3	Integrated Circuit SN7442N	534039
P4	Integrated Circuit SN7405N	534040
P5	Integrated Circuit SN7402N	534027
P6	Integrated Circuit SN7410N	534041
P7, P8	Integrated Circuit SN7404N	534042
P9, P10	Integrated Circuit SN7400N	534034
K1-K7	Relay, Dry Reed Electronic Inst. 2275-1C-5	471016
Q1, Q4	Transistor, 2N5416	528082
Q2, Q3	Transistor, 2N3439	528083
Q5-Q9	Transistor, 2N1304	528011
Q10	Transistor, 2N4921	528034
R1	Resistor, Variable 2K Beckman 77PR2K	311227
R3, R11, R13, R15, R17, R24, R25, R67, R68	Resistor, Metal Film 10K RN60C	324360

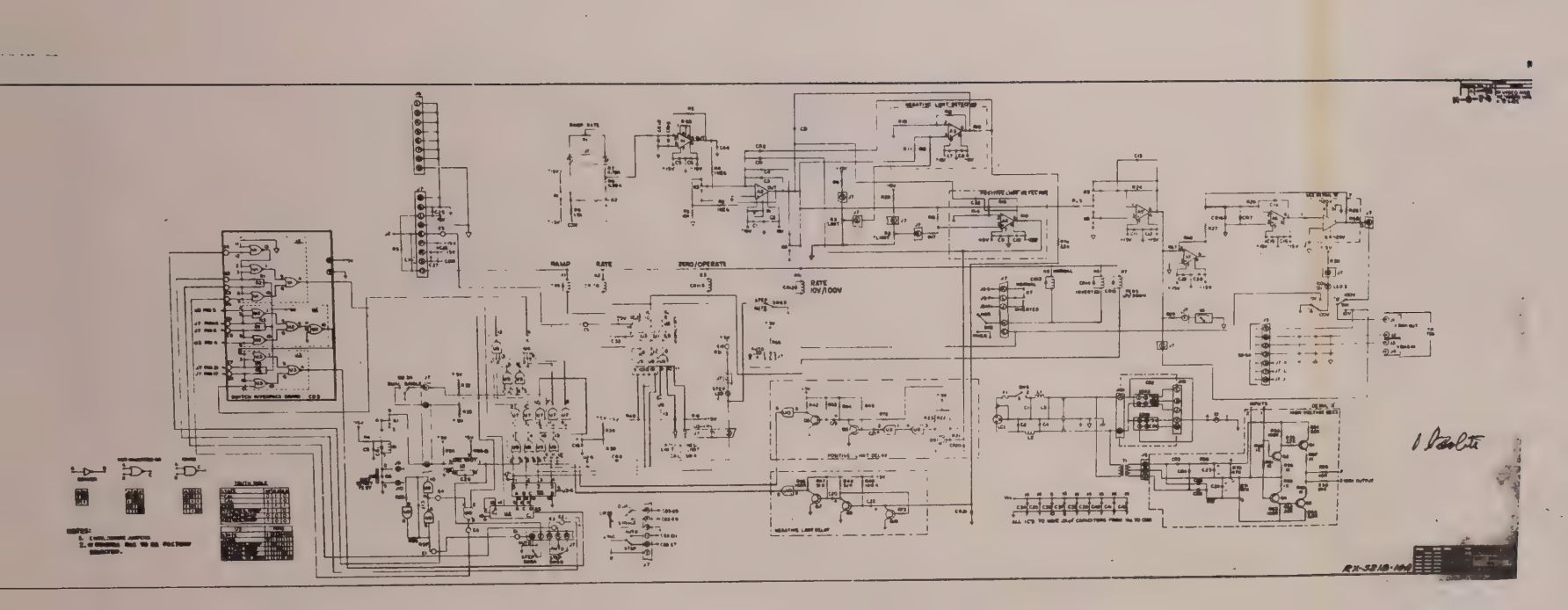
TABLE OF REPLACEABLE PARTS
(016005)
COMPONENT BOARD ASSEMBLY - DX5218-16-1&2 (Contd.)

Reference	Description	BEC Part No.
R4,R2	Resistor, Metal Film 1M RN60C	340599
R5	Resistor, Metal Film 100Ω RN60C	325219
R6	Resistor, Metal Film 2K RN60C	324276
R7	Resistor, Metal Film 7.5K RN60C	325403
R8,R72,R66	Resistor, Composition 15K 1/4W 5% AB	300110
R9,R20	Resistor, Metal Film 1.87K RN60C	325380
R10,R14	Resistor, Metal Film 1K RN60C	324240
R12,R16	Resistor, Metal Film 100K RN60C	324479
R18,R19,R21,R58,R73	Resistor, Composition 10K 1/4W 5% AB	300106
R22,R42,R45,R46,R49, R53,R63	Resistor, Composition 100K 1/4W 5% AB	300130
R23,R32-R34,R40,R41, R44,R48	Resistor, Composition 5.1K 1/4W 5% AB	300099
R26	Resistor, Metal Film 40.2K RN60C	325456
R27	Resistor, Metal Film 4.02K RN60C	324312
R28,R39,R50,R51	Resistor, Composition 100Ω 1/4W 5% AB	300058
R29	Resistor, Metal Film 20K RN60C	324395
R30,R31,R35,R37, R52,R56,R57,R59, R60,R61,R69	Resistor, Composition 1K 1/4W 5% AB	300082
R36	Resistor, Composition 750Ω 1/4W 5% AB	300079
R38	Resistor, Composition 30K 1/4W 5% AB	300117
R43,R47	Resistor, Composition 51K 1/4W 5% AB	300123
R54,R64	Resistor, Composition 3.9K 1/4W 5% AB	300096
R55,R62	Resistor, Composition 22K 1/4W 5% AB	300114
R65	Resistor, Variable 10K Beckman 77PR10K	311233
R70,R71	Resistor, Composition 47K 2W 5% AB	304127

TABLE OF REPLACEABLE PARTS

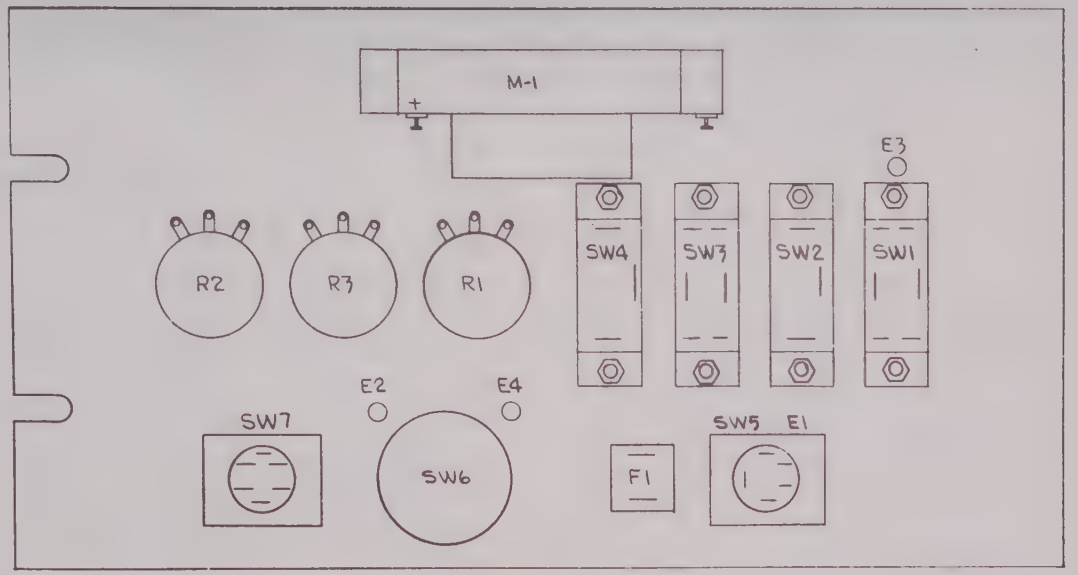
POWER SUPPLY ASSEMBLY - CX5218-22 (016006)

Reference	Description	BEC Part No.
PS1	Power Supply, Philbrick 2203 ± 15V	421464
PS2	Power Supply, Philbrick 2206 ± 5V	421465


RAMP
RATE
ZERO/OPERATE
RATE
10V/100V

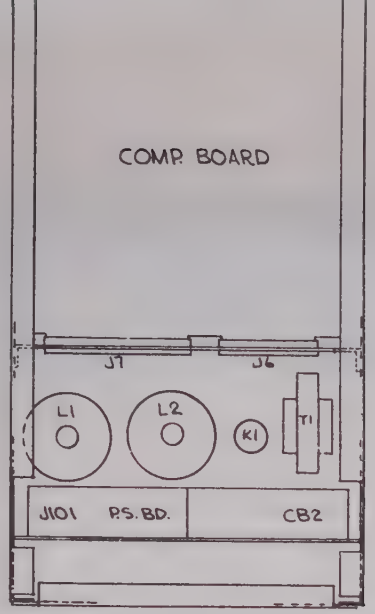
M-8-74 M-10-77 REVISIONS

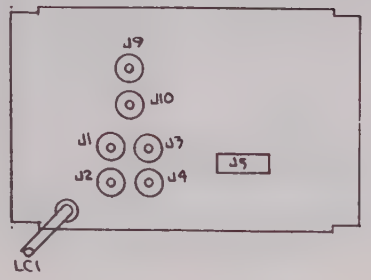
ZONE	REV	DATE	SIG.	DESCRIPTION
	A	3-1-74		CHANGED SW1 & SW3 TO 6 (SIX) CONTACTS



USED ON	TOLERANCES	BOONTON ELECTRONICS CORPORATION PARSIPPANY NEW JERSEY
16A	2 PLACE DECIMAL .010 3 PLACE DECIMAL .005 UNLESS OTHERWISE SPECIFIED	FRONT PANEL REAR VIEW
	SCALE:	
	DRN 9/24/72	
	CKD 3/1/74	
	APP 3/1/74	SH. OF B 016003 A

BX-5218-23-4





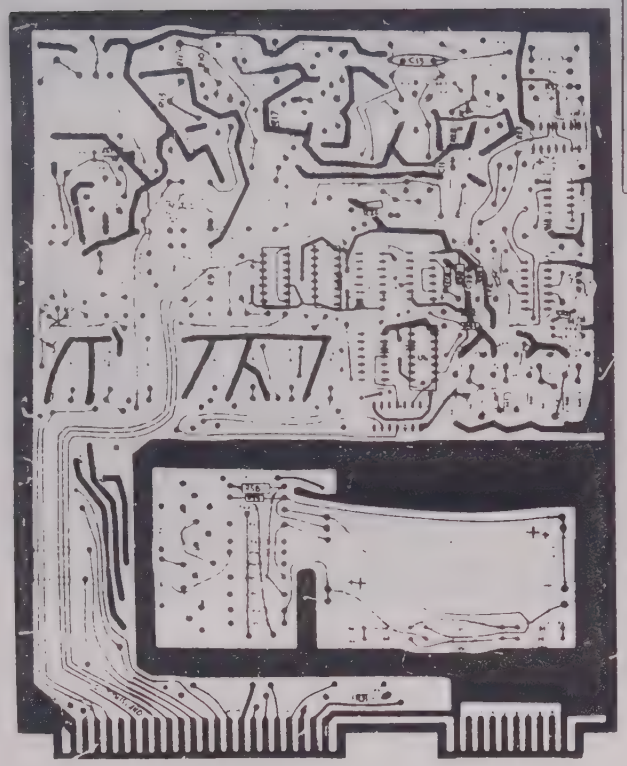
MADE ON			TOLERANCES	BOONTON ELECTRONICS CORPORATION	PARSIPPANY NEW JERSEY
16A			2 PLACE DECIMAL ±.02 3 PLACE DECIMAL ±.010 UNLESS OTHERWISE SPECIFIED	ASSY, CHASSIS TOP & REAR	
			SCALE:		
			DRN JWM 9/23/72		
			CHD		
			APP	DWG NO C-016004	A

3-24

11-8-74 M-10-77

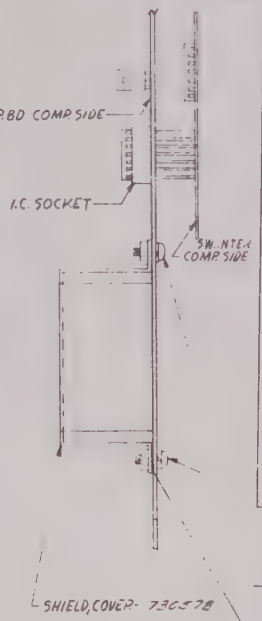
B 11/8/03 New REDRAWN REVISED

C 9-17-79 ADDED PM SER. NO. ECN 2167



PART NO.	QUAN.	DESCRIPTION	REF. SYM.
528082	2	Transistor, 2N5416	Q1, Q4
528083	2	Transistor, 2N3439	Q2, Q3
528011	5	Transistor, 2N1304	Q5–Q9
528034	1	Transistor, 2N4921	Q10
534038	1	I.C. SN74121N	U1
534033	1	I.C. SN7493N	U2
534039	1	I.C. SN7442N	U3
534040	1	I.C. SN7405N	U4
534027	1	I.C. SN7402N	U5
534041	1	I.C. SN7410N	U6
534042	2	I.C. SN7404N	U7, U8
534034	2	I.C. SN7400N	U9, U10
421021	3	Op. Amp. 1421	A1, A5, A7
421015	1	Op. Amp. 1021	A2
421018	3	Op. Amp. 1413	A3, A4, A6
471016	7	Relay, Elect. Inst. 2275-1C-5	K1–K7

PART NO.	QUAN.	DESCRIPTION	REF. SYM.
224124	16	Capacitor, .1μf 25V Ceramic	C1, C2, C5–C12, C15, C16, C25, C29, C30, C44
236011	1	Capacitor, .1μf 100V 20%	C3
236007	1	Capacitor, 1μf 100V 20%	C4
224134	3	Capacitor, .01μf 25V Ceramic	C13, C26, C27
234036	1	Capacitor, .047μf 200V 20%	C14
234034	1	Capacitor, .5μf 100V 20%	C17
283275	3	Capacitor, 1μf 50V	C18–C20
283237	1	Capacitor, 22μf 15V	C21
283193	1	Capacitor, 10μf 25V	C22
283298	2	Capacitor, 200μf 250V	C23, C24
234005	1	Capacitor, .1μf 200V 10%	C28
200900	2	Capacitor, 2000pf 500V 5% Mica	C31, C32
224119	10	Capacitor, .01μf 100V Ceramic	C33–C42
311227	1	Resistor, Variable Trimpot 77PR2K	R1
326700	5	Resistor, 1Meg 1/8W 1% MF	R2, R4, R12
324360	9	Resistor, 10K 1/8W 1% MF	R3, R11, R13, R15, R17, R24, R25, R67, R68
324099	1	Resistor, 66.5Ω 1/8W 1% MF	R5
324324	1	Resistor, 4.99K 1/8W 1% MF	R6
340321	1	Resistor, 4.75K 1/8W 1% MF	R7
300110	3	Resistor, 15K 1/4W 5% CC	R8, R66, R72
325380	2	Resistor, 1.87K 1/8W 1% MF	R9, R20
324240	2	Resistor, 1K 1/8W 1% MF	R10, R14
324479	1	Resistor, 100K 1/8W 1% MF	R16
300106	4	Resistor, 10K 1/4W 5% CC	R18, R19, R21, R73
300130	7	Resistor, 100K 1/4W 5% CC	R22, R42, R45, R46, R49, R53, R63
300099	8	Resistor, 5.1K 1/4W 5% CC	R23, R32–R34, R48, R47, R44, R48
325456	1	Resistor, 40.2K 1/8W 1% MF	R26
324312	1	Resistor, 4.02K 1/8W 1% MF	R27
300058	4	Resistor, 100Ω 1/4W 5% CC	R28, R29, R50, R51
300082	11	Resistor, 1K 1/4W 5% CC	R30, R31, R35, R37, R52, R56, R57, R59, R60, R61, R69
300079	1	Resistor, 750Ω 1/4W 5% CC	R36
300117	1	Resistor, 30K 1/4W 5% CC	R38
324395	1	Resistor, 20K 1/8W 1% MF	R39
300123	2	Resistor, 51K 1/4W 5% CC	R43, R47
300096	2	Resistor, 3.9K 1/4W 5% CC	R54, R64
300114	2	Resistor, 22K 1/4W 5% CC	R55, R62
311233	1	Resistor, Variable Trimpot 77PR10K	R65
304127	2	Resistor, 47K 2W 5% CC	R70, R71
300090	1	Resistor, 2.2K 1/4W 5% CC	R74
301128	1	Resistor, 51K 1/2W 5% CC	R58
530052	6	Diode, FD300	CR1, CR2, CR16–CR19
530088	4	Diode, 1N2070	CR3–CR6
530165	10	Diode, 1N4151	CR8–CR15, CR20, CR21
473026	1	I.C. Socket	SU3
473027	6	I.C. Socket	SU2, 4, 5, 6, 7, 9


COMP.BD COMP SIDE
I.C. SOCKET
SW. INTF. COMP SIDE
SHIELD, COVER- 730578
— INSTALL #4 40 X .25 PAN HD. SCREW AND #4 SPLIT LOCKWASHER 2 PLACES.
— INSTALL MYLAR STRIP FOR INSULATION

PARTIAL SIDE VIEW OF P.C. BOARD SHOWING MOUNTING OF COVER & SWITCH INTERFACE BD.

NOTES:

1. SEE C-016005 FOR JUMPERS ON DIP SIDE
2. THIS ASSY APPLIES TO SERIAL NO. 121 AND UP
3. * DENOTES R66 TO BE FACTORY SELECTED
4. K1 THRU K7 TO BE SLEEVED BEFORE MTG. TO BOARD

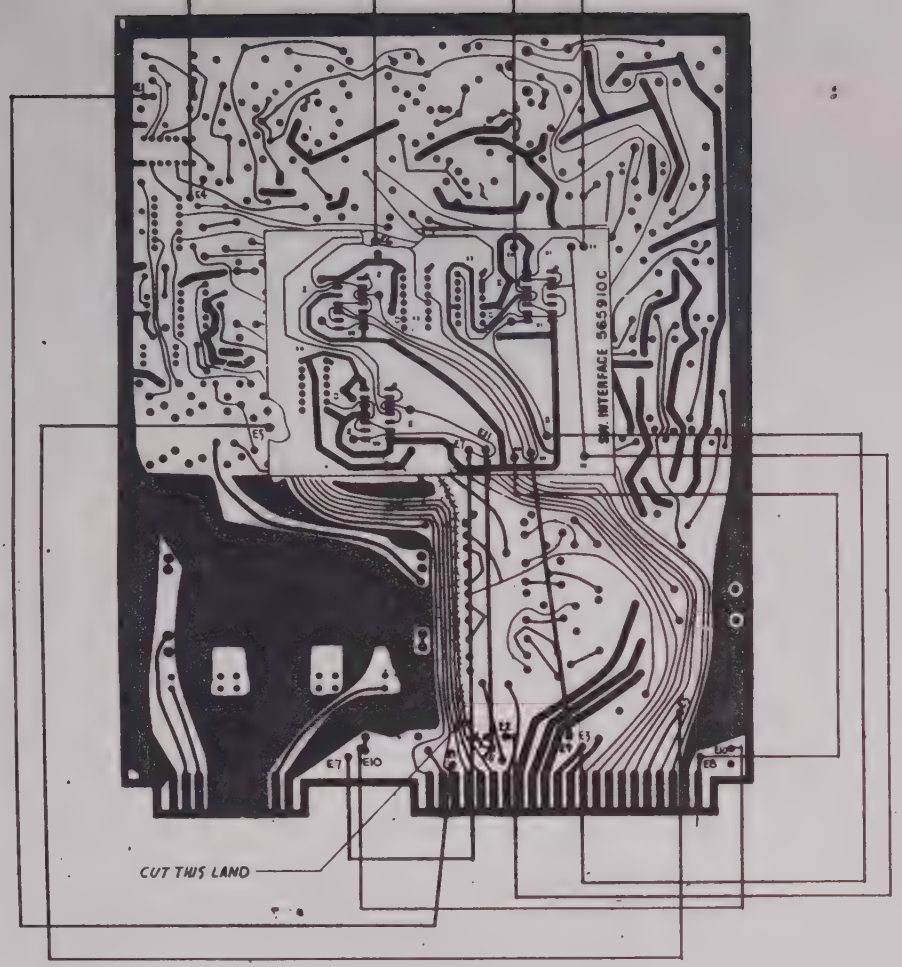
ASSOCIATED DRAWINGS:
765D16 765D12

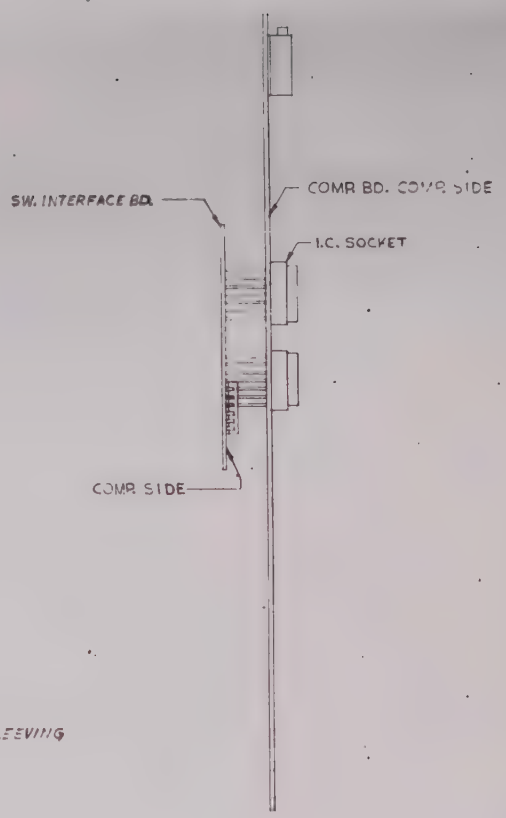
BOONTON ELECTRONICS

COMPONENT BD. ASSEMBLY (16A)

C 016005

16A





#24 AWG WIRE & SLEEVING

FOR SERIAL NO. 131 & UP

FOR IN HOUSE USE ONLY

USED ON			TOLERANCES		
16A			2 PLACE DECIMAL ±10 3 PLACE DECIMAL ±05 UNLESS OTHERWISE SPECIFIED		
			SCALE 1:1		
			DRN		12/6/73
			CKD		12-6-73
			APP		12-7-73

BOONTON ELECTRONICS PARSIPPANY NEW JERSEY

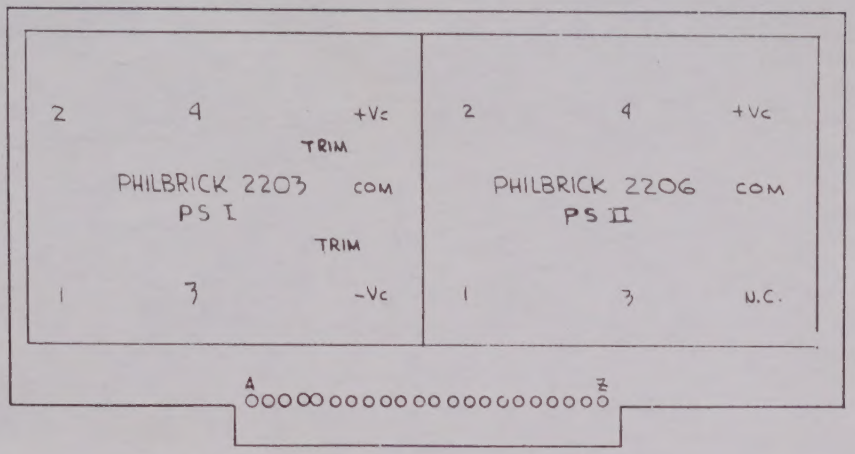
COMP. BD. & SW. INTERFACE ASSEMBLY

SH 2 OF 2 C 016003 B

C1-5218-93

M-10-77 REVISIONS

ZONE	REV.	DATE	SIG.	DESCRIPTION



PART NO.	QUAN.	DESCRIPTION	REF. SYM.
421464	1	P.S. Philbrick #2203	PSI
421465	1	P.S. Philbrick #2206	PSII

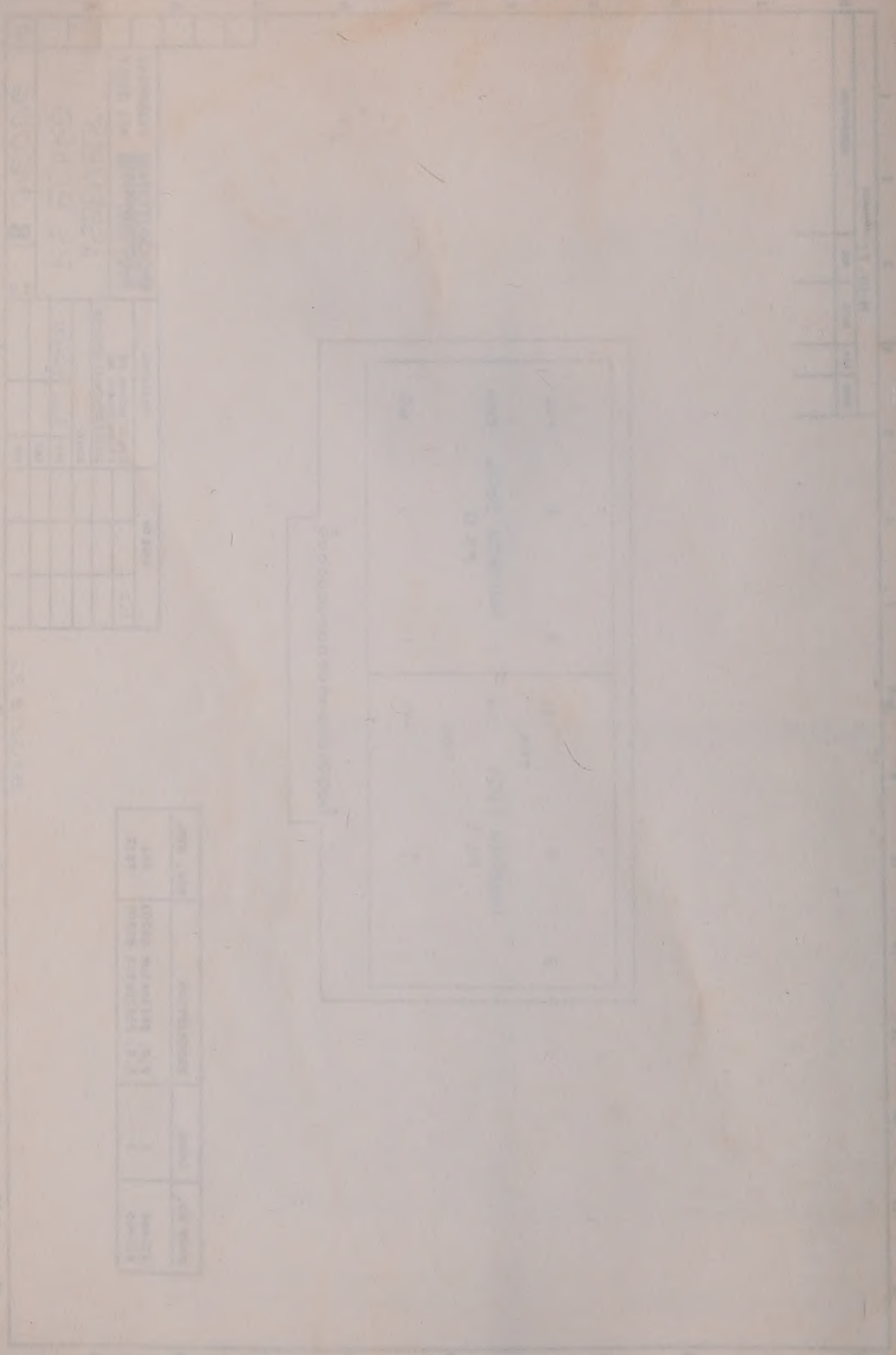
USED ON	TOLERANCES
16A	2 PLACE DECIMAL .010 3 PLACE DECIMAL .005 UNLESS OTHERWISE SPECIFIED
	SCALE:
	DRN Jim 9/28/72
	CKD
	APP

BOONTON ELECTRONICS CORPORATION PARSIPPANY NEW JERSEY

ASSEMBLY
P.S. BOARD

SH. OF B 016006 A

BX-5218 22



MP MASTER
MA24303